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ABSTRACT

This paper reviews relevant experimental literature on certain components of printed instructional materials which are commonly used in early childhood education for normal, at-risk, and handicapped children. The components examined include the use of color, instances of concepts, language style, number of answer options, the use of pictures and drawings, preferences of children, response-mode requirements, and successive versus simultaneous stimulus presentations. Issues regarding educational practice and research are discussed. (Author/MP)

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Designing, Utilizing, and Investigating Printed Instructional Materials for Early Childhood Education: A Review of Selected Considerations

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Printed instructional materials are commonly used in early childhood education settings for normal, at-risk, and handicapped children. This paper reviews relevant experimental literature on certain components of printed instructional materials: the use of color, instances of concepts, language style, number of answer options, the use of pictures and drawings, preferences of children, response-mode requirements, and successive versus simultaneous stimulus presentations. Issues regarding educational practice and research are discussed.

I. INTRODUCTION

Printed academic materials abound in primary schools, preschools, and nursery schools. On a given day, teachers use many materials: lotto games, flash cards, workbooks, feltboards, storybooks, etc. Similar materials, having been photographically reproduced, may be used by automated teaching devices in the classroom. Furthermore, teachers employ printed academic materials for teaching pre-math skills, pre-reading and reading skills, concepts, novel syntax and grammar, social behaviors, self-help skills, and a host of other behaviors. Teachers either make or buy these instructional materials. Whether made by teachers or instructional technologists, an overarching question emerges: How can printed academic materials be designed to maximize the attainment of the intended instructional objectives?

Two socio-political forces (at this writing) lend significance to the above question: the enactment of laws requiring competency testing of school children and the passage of the Education for All Handicapped Children Act of 1975 (P.L. 94-142). These two forces reflect a general climate of accountability, which has permeated early childhood education settings--eventhough, the various laws do not actually affect the settings. Thus, early childhood educators of normal, at-risk, or special children are more sensitive about the effectiveness of printed materials used in their classrooms, which may be reflected in the construction of the materials--whether by teachers, themselves, or by commerical preparers.

How, indeed, can printed instructional materials be designed to maximize the attainment of instructional objectives intended for children in

early childhood education settings? Two possible ways stand out, which can be used singly or in combination. The first way involves a direct empirical approach, wherein the learning of the children is closely and frequently monitored so that adjustments can be made quickly in the curriculum. Etzel (Note 1) has discussed this general approach and its permutations. The second approach involves the deductive application of prior research on instructional materials and young children, which seems like an intuitively rational action. However, putting the second approach into practice is easier in the abstract than in practice. It is obviously difficult for the practitioner to consult (not to mention, find) all of the relevant articles in the literature, which suggests the desirability of review papers as information sources for practitioners. Yet existing review papers suffer from some defects: (1) conclusions or principles presented in the papers are derived from subjects of all ages (preschoolers through adults)--e.g., Anderson (1967), which may be of limited generality when applied to one age group alone; (2) conclusions or principles presented may only be synopses of key findings, without any critical evaluation about the merits of those conclusions--e.g., Levie and Dickie (1973); (3) the conclusions and principles may principally reflect current practice and/or ideas about desirable practice, with minimal reference to experimental literature--e.g., Allen and Goldberg (Note 2); and (4) conclusions or principles presented may be clouded by a thunderstorm of theoretical invectives as exemplified by a quotation from a recent textbook on curriculum and the preschool child (Seefeldt, 1976):

> The highly mechanical approach of the behavioristic theory, which leaves no room for children's feelings, sensitivities, intrinsic motivation, or sense of autonomy in learning, has not been widely accepted by early childhood educators. Educators perceive this theory as being restrictive in nature and presenting a mechanistic view of man.....p. 6.

Early childhood educators and instructional technologists involved in early childhood education, therefore, might benefit by a review paper that does not venture into the adult literature, that critically assesses the reviewed documents, that shies away from generalizations not experimentally validated, and that remains open to the contribution of various theoretical approaches and their resulting research. The present review paper has been written with these objectives in mine.

The reader deserves a few caveats about this paper, however. Discussion is mainly limited to the stimulus properties of printed instructional materials, so that a reader desiring to acquire information about behavioral antecedents and consequences (e.g., prompting or corrective feedback) should consider consulting other reviews such as: Anderson, 1967; Glaser and Cooley, 1973; Allen and Rowbury, Note 3; or LeBlanc, Note 4. Stimulus control procedures are not covered in detail, since they have been covered quite comprehensively elsewhere (Etzel, Note 1). The reader seeking conclusive information about differential requirements for materials for normal, at-risk, and handicapped children will be necessarily disappointed: little comparative experimental research apparently exists that would allow the induction of comprehensive principles that are not already well documented (e.g., overselectivity among retarded or autistic children--Wilhelm & Lovass, 1976). Finally, the paper is not a review of reading

research and programs, mathematics research programs, etc. Rather the paper focuses on some of the underlying issues of printed academic materials that cut across such content boundaries and that may be of interest to practitioners and researchers in the area of early childhood education. These areas are: the use of color, instances of concepts, language style, number of answer options, the use of pictures and drawings, preferences of children, response mode requirements, and successive versus simultaneous stimulus presentations.

II. REVIEW OF LITERATURE

TO COLOR OR NOT? Travers (1969) reported that the use of color in pictures facilitated correct perception of motion by elementary-aged children (kindergartners, first graders, and third graders) and had no effect with preschool-aged children. In the same study, Travers found that correct recognition of themes also was improved through the use of color in pictures. The benefit was most pronounced for older elementary children, but preschoolers also improved their perception of themes. Travers' research may be of limited value, however, in prescribing the design of instructional materials. Though a well-designed study, the pictures were presented for only .25 sec via a tachistoscope, which is quite unlike the more leisurely perusal of pictures found in preschool classrooms; the reported advantage of color may disappear under more normal durations of presentations. In findings that may or may not be relevant to learning outcomes, several investigators have measured children's preference for color. Rudisill (1952) found that young children prefer

illustrations realistically colored. Samuels, Biesbrock, and Terry (1974) found that beginning readers have an overall preference for color illustrations over line drawings (which are preferred to illustrations). One study gives some clue as to young children's preference for color illustrations and learning. In a paired-associates task, Evertson and Wicker (1974) found that objects and color photographs were equally effective, but more effective than line drawings, for both nursery-school and first-grade subjects. However, the relevance of a paired-associates task to classroom teaching and learning is not clear.

Many investigators studying selective attention have noted that young children have strong preferences for color. Thus, in discrimination training, the use of color as a distractor or irrelevant dimension will likely impair the learning of young children unless children are given pre-training to reject color as a choice (Johnson, Warner, & Silleroy, 1971). The use of a preferred dimension as an irrelevant cue or the use of criterion-unrelated cues impairs the performance of handicapped children prone to overselectivity (e.g., Rincover & Koegel, 1977).

The use of color, then, seems to be indicated for storybooks and the like, but not necessarily for discrimination tasks. The appropriateness of color appears to hinge on the discrimination required and the degree of overselectivity found in the child or children. Consider a match-to-sample exercise involving kinds of fruit. If one were trying to teach an autistic child to match apples, then it might be better not to use a strawberry or cherry as an initial distractor, unless the trial involved line drawings only (no color) so that the match would be on the basis only of form. Later, color would be added gradually.

INSTANCES OF CONCEPTS. In teaching concepts, examples or instances are often presented to induce the child to learn the concept. Certain modes of presentation may affect outcomes. Blake (1976), reporting on comprehensive research undertaken at the University of Georgia, found that both retarded and normal pupils (aged eight through eleven) learned concepts better if the proportions of positive to negative instances was high. Smuckler (1967) conducted a somewhat more comprehensive study with normal second graders, in which the following ratios of positive to negative instances facilitated acquisition learning: 1st - 100% positive, 2nd - 75% positive, 3rd - 50% positive, and 4th - 25% positive. Smuckler reported somewhat different rankings for retention and transfer: 1st - 100% positive, 2nd - 50% positive, 3rd - 25% positive, and 4th - 75% positive. The rankings of ratios for positive to negative instances should be viewed with great caution for retention and transfer, for the retention and transfer tasks seemed to be weak measures of retention (45 min after training) and transfer (circling the correct answer instead of verbally signifying it). With a somewhat superior measure of transfer, however, Swanson (1972) published findings that indicated that the removal of negative instances resulted in overgeneralization--which might be an important concern with difficulty on multiple-discrimination tasks. Further, Swanson reported that the addition of a concept definition conferred no benefits over positive and negative instances alone, unless the concept definition was accompanied by an emphasis on the relevant stimulus discriminations. Klausmeier and Feldman (Note 5) further extended Swanson's findings; they published data to the effect that fourth graders (normal) attained a concept better with

a set of positive and negative instances rather than a definition of the concept alone, which in turn was better than a placebo treatment. Feldman's (Note 6) data suggest that at least one instance (either positive or negative) is required to effect a child's learning of a concept. These studies (Blake, 1976; Smuckler, 1967; Swanson, 1972; Klausmeier & Feldman, Note 5; Feldman, Note 6) certainly are suggestive but they require replication with younger children (normal and handicapped) to allow inclusions appropriate to this review.

LANGUAGE STYLE. Basal readers and other children's books often introduce syntax not commonly used by children. For example, basal readers often employ the form: "Father said, 'Go play with the dog'." The form, called direct discourse (subject, transitive verb, and object), may adversely affect a young reader's comprehension. Indeed, a study with severely to profoundly deaf children (ages 8.0-12.7) by Hargis, Evans, and Masters (1973) found that stories using a nondirect discourse format (i.e., speech patterns coming from the mouths of the characters à la comic books) produced superior readability compared to direct-discourse passages; the authors measured readability by the "Cloze" procedure. Whether direct discourse affects comprehension or retention is not known; further, the problem with direct discourse may be secondary to the language problems of hearing-impaired children. Accordingly, the impact of direct discourse merits further investigation; although the study by Hargis, Evans, and Masters (1973) signals direct discourse as a possible source of reading/listening problems.

Young children apparently do not understand the use of passive voice (Brown, 1976; Lovell & Dixon, 1967). In comprehension measures, preschoolers confuse the agent-object relationship of passive voice (e.g., "The cow was ridden by the moose"). Unless one is specifically trying to teach a child to understand the passive voice, the incidental use of it should be avoided in the construction and utilization of academic materials for young children.

Certain instructional objectives may indicate close attention to pronoun usage. If one is trying to facilitate imitation from storybooks, then it appears desirable to employ the first person over the third person. Jakibchuck and Smeriglio (1976) reported that an experimental comparison of two modes of speech by a child modeling social interaction revealed that first-person usage (e.g., "My name is Danny. I want to join the group") was superior to third-person speech ("That boy is Danny. He wants to join the group") in facilitating imitation.

NUMBER OF ANSWER OPTIONS. Educators have many folkways, one of which is to offer four or five options for an answer to a multiple-choice question with at least one nearly correct option in addition to the correct answer. The rationale for the tradition presumably is that it sharpens discrimination skills. The tradition, however, may not sharpen discrimination skills but dull them. Suppes and Ginsberg (1962) found that normal kindergarten children performed better on subsequent trials of a concept-discrimination task with three multiple choices if they were exposed to an initial 60 trials with only one answer option; that is, the choice was either a correct or incorrect member of the set. The findings are similar to those of Kaess and Zeaman (1960) in their study of college students.

Further, Sidman and Stoddard (1966) observed that their data and experience revealed that errors begat errors for both normal and handicapped children. Thus, an increase in the number of initial answer options increases the probability of an incorrect response that, in turn, increases the probability of future errors.

The beneficial effects of restricting initial response options offers a theoretical explanation of the superiority of the Edmark over the Sullivan and Merill programs for teaching reading to educable mentally retarded children (Vandever, Maggart, & Nasser, 1976). During the initial phases of responding in the Edmark program, a child is virtually forced to make the correct response; distractors (other sight words) are faded into subsequent trials. That is not the case with the other reading programs.

Perhaps initial training with only one response option can be throught of as pre-training in selective attention, which might be quite functional for certain populations of handicapped children. It is good to recall that Zeaman and House (1967) found that mentally retarded children did not know where to focus attention during the initial stages of a learning task, so that the inclusion of initial distractors in the form of additional answer options seems dysfunctional.

PICTURES AND DRAWINGS. Researchers and educators have argued about the utility of pictures in promoting reading and oral comprehension for many years. Nevertheless, certain research seems relevant to settling the dust kicked up by the argument.

Using the same paradigm, Braun (1969) and Samuels (1967) reported that sight-reading training using pictures was less effective than with-

out pictures. However, given the findings of Staats, Staats, Shultz, and Wolf (1962), it seems very probable that the findings of Braun (1969) and Samuels (1967) are an artifact of schedules of reinforcement. That is, the groups receiving sight-reading training with pictures were on a multiple schedule of CRF-EXT; whereas, the groups receiving sight-reading training with words only were on a tandem schedule of CRF-EXT. In the studies by Samuels and Braun, children receiving training via the pictures cues were shown a card with a noun and appropriate picture; the child was praised for a correct response. The next trial had only the word printed on the card; the child's responses were not consequated in any way. Thus, the cards with a picture acquired S^D properties, and the card with the word acquired only S^Δ properties. Children trained under the word-only condition had a different schedule. During the first trial (the training trial), the child was praised for correct responses. During the next trial (the test trial), the child's answer was not consequated. Training and test trials continued to alternate, but there was no clear discriminative stimulus associated with the card per se and praise. Lest this difference in scheduling be lightly dismissed, recall that Staats, Finley, Minke, and Wolf (1964) have shown that reading responses exhibit familiar patterns of behavior resulting from schedules of reinforcement, although the patterns were not as pronounced as those found in the operant animal literature. Stephens, Pear, Wray, and Jackson (1975) also have shown an effect of different fixed-ratio schedules on the picture-naming behavior of young retarded children.

Samuels' (1970) claim that these prior studies prove that pictures interfere with sight reading is unwarranted, given the confounding schedules of reinforcement. His claim is even more suspect when one examines research by others involving different techniques. For example, in a study involving a different paradigm, Corey and Shamow (1972) showed that picture cues, successively faded, were very effective in teaching sight reading. Additionally, Staats, Staats, Schultz, and Wolf (1962) taught textual reading in a procedure involving picture cues.

The method used by Samuels and Braun in teaching sight words via picture cues might be labeled as superimposition. That is, the picture (e.g., a drawing of a boat) is printed above or below the word (e.g., the word boat). During training trials involving superimposition, the picture is not altered in any way. Two other studies have compared the superimposition paradigm to a fading paradigm, which does, however, include systematic alterations of the prompting picture. That is, the fading technique is characterized by a progressive withdrawal of the picture, over trials: (1) the picture may become fainter, or (2) the picture may be obliterated by successive overlays of dense screens. Corey and Shamow (1972) reported in a study of normal children that a fading procedure resulted in far better retention of sight words than a comparable superimposition procedure. Dory and Zeaman (1973) replicated the finding with retarded children. Despite the demonstrated effectiveness of the fading procedure in these two studies, one cannot assess the effectiveness of the fading procedure compared to a look-say procedure alone (no pictures), for neither study had the appropriate comparison. A study comparing the three methods should be run with both normal and handicapped preschoolers.

In teaching sight words using a superimposition technique, there are some procedures that appear to produce differential results (Hawker, 1968). Specifically, the author found that retarded children with an average mental age of 6.5 years evidenced better recall and recognition if trained on stimuli using a word-picture vs. picture-word presentation. Figure 1 illustrates the difference in the two formats. Hawker attributes the result to the meaningfulness of the response stimuli in the word-picture presentation, a finding which he reports has been replicated in the paired-associates literature.

In another dimension of learning, pictures have been found to facilitate oral comprehension. In a programmatic series of experiments, Levin, Shemion, and Guttman (1975); Levin, Bender, and Lesgold (1976); and Guttman, Levin, and Pressley (1977) found that pictures presented after each sentence in a story facilitated the oral comprehension of nursery-school through third-grade children. The effect was not explained via any rival hypotheses, for several were evaluated and found wanting. Importantly, Guttman, Levin, and Pressley (1977) experimentally demonstrated that pictures (actually colored drawings) facilitated the prose comprehension of events or items <u>not</u> depicted as well as those depicted.

The findings of Levin and colleagues would appear to have a number of implications for the design and utilization of storybooks for early childhood education settings, especially if storybooks can be made to improve a young child's oral comprehension. A number of studies (Fischer & Torney, 1976, Whitehurst, 1977; Whitehurst, Ironsmith, & Goldein, 1974; Zebrowitz-McArthur & Eisen, 1976) present evidence that oral comprehension

is relevant to imitation, which may be a crucial variable in the education of handicapped children (Baer & Sherman, 1964). Whitehurst (1977) argues, on the basis of his and others' research, that selective imitation appears to depend on comprehension rather than being preliminary to it, since what a child selects to imitate depends, in part, on the linguistic relations that the child has come to comprehend. Thus, if storybooks or storybook analogs (a series of pictures held up for viewing by the child) can facilitate prose comprehension, they should also facilitate the imitation of that prose. There is evidence to support that logic. Brown (1976) found that picture cues or enactive referents (the actual objects, which were more effective) are critical to the acquisition and comprehension of certain linguistic relations (e.g., passive voice--"The fire truck was pushed by the car"). Furthermore, Boroughs (1970) reported in an experiment with culturally disadvantaged three-year-olds, that after only three months of exposure to daily book reading by mothers at home, the children in the experimental group scored significantly higher than children in the placebo group on two of the five measures of verbal skills, and significantly higher than the control group on four of the five measures. The tests used in the Boroughs study were the Peabody Picture Vocabulary Test and the Stanford-Binet.

Pictures can also improve the math skills of EMR children with a mental age not exceeding seven years. Goodstein (1972) studied three levels of EMR children (MA of 7, 8, and 9 years) and found that the younger MA children (7) worked math problems with more errors unless pictures were presented showing the sets to be arithmetically manipulated (e.g., 5 dogs

and 3 cats). The study's findings were strengthened by probing a variety of picture and non-picture conditions.

In teaching sight reading with picture cues, there is a small problem of which an educator or researcher should be aware. Hall (1961) observed that pictures are not always reliable elicitors of words. A picture of an airplane, for example, might elicit several appropriate answers from a child: "plane, airplane, or jet." Although some have argued that the ambiguity of pictures is reason enough not to use them as cues, that argument simultaneously misses the point of language and obscures an easy training remedy. From a language perspective, nouns seldom have an exact iconic referent; nouns generally refer to a class of objects. From a training perspective, the problem is easily remedied. The teacher should define the picture with the appropriate noun (e.g., "This is an airplane. What is this?"). Indeed, a clever educational technologists might seize the occasion of teaching sight reading to teach object-classes as well.

The inherent ambiguity of illustrations alluded to by Hall (1961) raises another issue about children's perceptions of illustrations: the accuracy and thoroughness of children's perceptions of illustrations. Miller (1938) found that 3rd-grade children perceived only a fraction of the details in a variety of pictures. Thirty years later, Travers (1969) found that children increased their perception of items (whether correct or incorrect) in pictures as a function of age. Furthermore, Travers found that nursery-school children identified fewest items in the pictures and had great difficulty with the accurate perception of motion or themes. As noted earlier in the paper, Travers' findings are quite interesting

but of possible limited generality, since the pictures were presented through a tachistoscope for only .25 of a sec. Young children do appear to have difficulty with a number of concepts often portrayed in two-dimensional illustrations or photographs: the perception of depth (Oh, 1968), the perception of relative size (Wilcox & Teghtsoonian, 1971), and relative distance (Wohlwill, 1965). In addition, some artistic conventions are not always meaningful to young children (e.g., action lines indicating movement--Brooks, 1977). The fact that content of pictures or illustrations is not inherently obvious to young children should serve as a fillip for the separate field-testing of the pictorial content of storybooks, etc. Specifically, if pictorial materials are to be used, a sample of the target child population should be asked to "tell what's happening" in each picture as a means of ascertaining the correspondence between the pictorial and prose components, since it is possible that the two could be working against one another.

PREFERENCES OF CHILDREN. Children have distinct preferences for stimulus characteristics, and the question of whether those preferences should be reflected in the design of instructional materials is one that should be discussed in this review. Before any attempt to integrate those preferences into the design of instructional materials, some of the preferences of young children should be enumerated.

In color-form discrimination tasks, young children typically prefer color over form (Suchman & Trabasso, 1966). Stewig (1975) has shown that preschoolers prefer illustrations that are unrealistically colored, lacking in modeling or shading, less detailed, and shallow in depth cues.

Unfortunately, Stewig did not probe preferences in combination. Investigating young children's picture preferences, French (1952) reported that kindergartners preferred the following:

1. Even, clear-cut, unbroken, unaccented lines as a definition of the outlines of all objects.

2. Generalized local color within the drawn outlines, without variations in shading, highlighting, or texture.

3. Representation of all objects as flat, two-dimensional areas, with each object complete on the page and presented in its most characteristic silhouette, although this may necessitate the representation of several aspects of the same object.

4. Isolation and clear definition of each object against the paper, without implied depth--at most, the overlapping or raising on the page of a few objects to indicate distance.

The preference described above is juxtaposed to drawings more like that drawn by an adult. In the same year (1952), Rudisill conducted a somewhat more sophisticated study in which children's preferences for uncolored photographs, colored (by an artist) photographs, colored drawings--realistic in form and color, outline drawings--realistic in form but outlined in color without regard for realistic effect, and colored drawings, conventionalized in form (not defined) and decorative but unrealistic in color. All possible comparisons were run, across kindergartners through sixth graders. A preference (ascending with age) prevailed in 69 out of the 70 comparisons: colored photographs over black-and-white photographs, black-and-white photographs over all drawings, etc. The one exception involved a preference by kindergartners for conventionalized colored drawings over colored outline drawings. It is important to note that the preference for realism increases quite steadily and significantly from kindergartners through sixth graders. In a study on fine-grained prefer-

ences, Loeb (1964) has shown that nursery-school children prefer cartoon faces with pronounced expressions (either happy or unhappy) over neutral cartoon faces. Finally, Cantor and Cantor (1966) reported that kindergarten children will project slides of unfamiliar stimuli longer than familiar stimuli.

How do these preferences interact with children's learning? First, as discussed earlier in the review, young children's preference for color can interfere with the learning of discrimination tasks if color is an irrelevant or criterion-unrelated cue (see Etzel, Note 1, for a fuller discussion of irrelevant or criterion-unrelated cues). In a practical vein, an early childhood educator might find that some children's puzzles generate difficulties because color is an irrelevant cue to the assembly of a puzzle. Consequently, in designing or choosing puzzles for children with problems of overselectivity, one might wish to minimize the use of color or insure that it was criterion-related. Second, the use of photos versus line drawings in materials requiring recall of pictorial material, for paired-associate learning, seems to be most facilitated by photographs in comparison to line drawings (Evertson & Wicker, 1974); the findings of Brown (1976) that the comprehension of passive voice could be improved through the use of color photographs does not conflict with the principle since young children do have a preference for photographs (Rudisill, 1952). Third, the issue of children's preferences may become much more complex in learning situations in which children's responses are consequated so that their preferences for stimuli (fast becoming discriminative stimuli) become tied to stimuli most associated with previous mastery (White, 1959);

in situations in which responses have never been consequated, a child's preference may indicate a preference for the novel, the unfamiliar (e.g., Cantor, 1968, Cantor & Cantor, 1966). Indeed, some research shows that children with either the chronological or mental age of under 4½ will choose the novel stimulus on the first trial or two of a two-choice discrimination task (Loeb, 1972), which partially resembles the preference tasks used by French (1952) and Rudisill (1952). This theoretical construction needs to be stated in a concrete example: Suppose a child is consequated for his or her responses to questions about the content of storybooks with line drawings on a regular basis in a classroom; if asked to choose between books with line drawings or photographs while in the classroom under the consequated conditions, the child will likely evidence a preference for storybooks with line drawings; however, in a non-consequating environment, that same child may prefer storybooks with photographs--possibly because of their novelty or complexity value. This hypothesis and its concrete example suggests that children's preferences may reflect the prevailing contingencies. Accordingly, an instructional designer might wish to program some variability in the visual aspects of instructional materials for young children so that children's preferences (incidentally acquired) would not limit their sampling behaviors of new materials.

RESPONSE MODES. A child may respond appropriately or inappropriately to the presentation of printed materials: inappropriately, a child might throw lotto cards; appropriately, a child might point to the correct match. Even within these broad categories there is considerable variation. Other reviewers (e.g., Allen and Rowbury, Note 3) have dealt with the variations

in and the management of inappropriate responses as well as consequences for correct responses. Accordingly, this review probes some of the response topographies associated with appropriate responses.

The dividing line in the discussion of appropriate response modes is the distinction between overt and covert responses. Both overt and covert responses should be defined: overt responses typically refer to behaviors such as labeling, pointing, tracing, etc.; whereas, covert responses typically refer to behaviors such as attention-to-task, "thinking the answer," etc. While assenting to the definitional differences, educators and researchers of differing philosophies have asked the same question: Which is superior, overt or covert responding? After reviewing some relevant research, a retort to the question may be possible.

Overt responding, in the guise of tactual-kinesthetic experiences, has received much attention from special educators. A number of investigators and educators argued that "slow or deficient" learners who might have difficulty with only visual stimuli would benefit by kinesthetic experiences (e.g., Fernald & Keller, 1921; Montessori, 1964). This kinesthetic postulate stimulated some notable and often cited studies. Berman (1939) reported that tracing nonsense syllables did not facilitate their recall; whereas tracing geometric forms did facilitate their recall. However, Kirk (1941), in a sufficiently controlled study, reported that tracing meaningful words did facilitate the recall by slow readers. In a study comparing two different methods, Pulliam (1945) found that the use of indented word cards (which the subjects finger traced) versus plain printed sight-word cards facilitated recall two weeks later; but the clear specifica-

tion of procedures used in the compared methods revealed a significant confound. That is, the tracing method had many more overt response requirements per word: a ratio of 5 to 1 responses were required for the tracing method versus the sight-reading/discussion technique. Thus, one cannot tell whether the effect was due to practice per se or tracing. In a study 20 years later designed to test the kinesthetic hypothesis, Ofman and Shaevitz (1963) found that the tactual-kinesthetic hypothesis was not necessary to explain the effect, because requiring a slow reader to track visually the outline of the word through the assistance of a moving light produced the same effect as finger tracing. Ofman and Shaevitz suggested that systematic exposure to the salient stimuli produced the benefit not not tactual-kinesthetic experiences, because both finger tracing and light tracing were more effective than plain sight reading. There are apparently several methods of enforcing attention to salient stimuli through overt responding, which result in superior learning.

Several investigators have reported learning gains if the child is required to make some verbalization about the salient stimuli. Keislar and McNeil (1962) found that oral responses by kindergartners facilitated learning. Repeating each sentence of a story improves recall, a finding replicated in three separate experiments (Levin, Bender, & Lesgold, 1976). Mere repetition, however, may not be the same as labeling the salient stimuli; Zimmerman and Bell (1972) found that children (ages 9-12) performed better on a task if they did not verbalize the actions of the model. In noting that kindergartners do not label things as spontaneously as older children, Gagne and Rohwer (1969) also note in their review that

verbalizations by the child about the key discriminations do facilitate learning.

Another beneficial mode of overt responding appears to be pointing. Johnson, Warner, and Lee (1970) found that a requirement to point out relevant characteristics of stimuli of a rule concept improved learning. In a case study, Kramer and Krug (1973) published an account of a technique to teach addition and subtraction to retarded children. Their technique superimposed one-to-one correspondence points of appropriate value on the arabic numbers 1 through 9; these points, which were faded, were counted by each pupil. Another investigator, Sabbert (Note 7), simultaneously developed and used a similar pointing and counting technique. Though Sabbert's study was not designed to evaluate the pointing and counting procedure per se experimentally, the study did suggest that the pointing and counting technique was effective.

It is common to think of storybook reading as an occasion for young children to remain passive and just to listen to the narrative; however, some research suggests that more active responses by the children may have a number of desirable behavioral outcomes. Blank and Frank (1971) conducted a study on the effects of storybook presentation on the psycholinguistic performance of normal kindergartners. When the kindergartners were asked to "tell the story" after the storybook presentation, they found that the children produced more correct or appropriate syntactic transformations if each sentence was read, the children were required to repeat the sentence, and the story read again in its entirety as compared to the condition in which the story was read twice to the children with

no intervening repetition. The condition in which children were required to repeat the sentences also improved their correct responses to a variety of what and where questions. Active responses to storybook stimuli would also appear to facilitate the social behavior of preschoolers with behavioral deficits. An experiment by Strain and Wiegerrink (1976) showed that mands by the teacher to the children to act out characters (e.g., "Sally, you be mama bear") clearly resulted in increased social play during subsequent freeplay periods. Social play was defined as sharing, holding hands, taking turns, etc. These two studies suggest that the inclusion of active response requirements in storybooks greatly broadens the range of instructional objectives obtainable through storybooks.

There are some general observations about overt responding that merit attention. Levie and Dickie (1973) argue in their review that overt responding is most effective if the behavior is not trivial or already in the subject's repertoire. On the opposite pole, Greene (1966) observes that overt responses may well be disadvantageous if the response is likely to produce an error (cf. Sidman & Stoddard, 1966). These two observations not only explain some of the contradictory results of experiments testing the effects of overt responding but also suggest that the benefits of overt responding are rather U-shaped. Finally, the recent research by Sabbert (Note 7) clouds the argument about overt and covert responding somewhat. Using a programmed-instruction procedure (quintessentially overt responding), Sabbert proposed to evaluate the number of children (1 through 5) who could be grouped together and go through a stimulus-control program for teaching addition and still reach criterion performance.

Recalling that each child made only some fraction of the total responses in each program step, Sabbert found that the program was still effective with five children composing the group, which suggests that observing other children respond overtly may (under certain circumstances) be sufficient to instruct children with printed academic materials.

SUCCESSIVE VERSUS SIMULTANEOUS PRESENTATIONS. Various temporal relationships can be manipulated in the construction of printed academic materials for young children. In match-to-sample tasks, the match and the sample could be printed on the same page, or the sample could be printed on the flip side of the page. In teaching a concept (e.g., trees), an array of instances and non-instances of trees could be presented simultaneously or successively. Furthermore, a particular book or set of worksheets for preschoolers might teach several concepts, which might be successively organized or randomly interspersed. Although considerable research exists on the effects of these temporal relationships among adults, little research exists that would guide a teacher or instructional designer in choosing optimal temporal relationships for printed academic materials for young children, and the little research that exists often lacks unanimity.

At least two studies have been published on simultaneous versus delayed match-to-sample tasks. Most recently, Bilsky, Evans, and Martin (1975) reported pertinent data from their experiment on retarded primary and preschool children in which the task was to learn to discriminate the letters b and d. In a 2 X 2 factorial design (simultaneous versus delayed match-to-sample and sample redundant versus sample non-redundant stimuli--that is, all non-match stimuli were either all the same or all different), only

one effect emerged: the simultaneous condition resulted in fewer errors. No differences were observed on a transfer task. Findings of the authors could have been idiosyncratic to retarded subjects, yet the results mesh nicely with those of Samuels' (1969) on normal kindergartners. Samuels (1969) found that normal kindergartners produced fewer incorrect responses under a simultaneous juxtaposed to a successive match-to-sample condition. He, however, noted that children in the delayed condition performed better than those in the simultaneous condition on a paired-associates task (presumably a transfer task) in which the training letters were the stimulus items. In a latter paper that attempted to integrate the differential findings, Samuels (Note 8) theorized that simultaneous match-to-sample procedures should precede delayed match-to-sample procedures in basic reading-skill programs; Samuels argued that the initial simultaneous condition would sharpen the early discrimination skills of the child, and the subsequent delayed match-to-sample experience would help establish a learning schema.

One major point of agreement exists between the study by Bilsky, Evans, and Martin (1975) and Samuels (1969); simultaneous match-to-sample presentations would appear to facilitate acquisition. The two studies disagreed on their findings about transfer, which suggests that further study is warranted across a range of transfer tasks.

Horowitz, Lampel, and Takanishi (1969) tested the effects of three different presentation methods (unitized, simultaneous, and successive) on the recall of normal nursery-school children. In a series of studies, the authors found that unitized presentations (e.g., a spoon in a shoe in

a box) improved the recall of the older nursery-school children but not the younger, unless required to name each item. The authors found that simultaneous presentations were superior in facilitating recall as compared to successive presentations but not unitized presentations. However, the finding that simultaneous presentations were superior to successive presentations in facilitating recall for this group of young children may have been due to the fact that the children were required to name the objects at presentation, which would have made the naming of the objects in the simultaneous condition successive in the aural modality and possibly served to focus attention of the children.

The studies on teaching concepts are at odds with themselves and some of the previous studies concerning successive versus simultaneous presentations. Smuckler (1967) published a finding that children ($\overline{X}$ = 8.2 years) made more correct identifications of trapezoids during acquisition if the instances and/or non-instances were presented successively versus simultaneously. There was no differential effect on transfer or retention by presentation condition; however, the transfer task was a weak measure of transfer--involving a small change in response topography and stimulus conditions, and similarly the retention task involved a time lapse of only 48 hours. One should note, too, that the advantage of successive presentation during acquisition held true for only the first trial block; on subsequent trials, the performance of the successive, simultaneous, and control group tended to emerge. (Ratio of positive to negative instances was quite significant, but no interaction effects were observed.)

Schelly (1973) conducted a study on somewhat older normal and retarded children and reported that successive presentations were far more effective in teaching several concepts to the three groups of children. The strong effect noted in Schelly's study versus the weak effect in Smuckler's study might be traced to the fact that Schelly provided confirmation on answers, whereas Smuckler did not. Unfortunately, Schelly made no measures of transfer or retention. Campoine and Brown (1973) presented findings at odds with those of Smuckler and Schelly: that is, no differences were noted in initial learning on the basis of either successive or simultaneous stimulus presentations, which the authors ascribe to the fact that children were told the answer at the beginning of the problems (unlike the previous studies) and thus learned very quickly.

Taken together, the three studies would suggest that the successive presentation of concept instances would be most desirable for teaching younger children, but whether this principle extends to preschool-age children is unknown. It is good to recall that Smuckler notes that previous research on simultaneous versus successive stimulus presentations (conducted almost exclusively on college students) favors simultaneous presentations--in marked contrast to the three previous studies.

Concepts are seldom taught singly to young children. Indeed, a variety of concepts (e.g., flowers, trees, cars, or building) could be taught sequentially or concurrently. Which method is superior? Two studies suggest an interesting answer; that is, it depends on the instructional objective. Cartwright (1963) discovered that retarded adolescents receiving unsystematic (concurrent) programmed-instruction sequences performed

better on transfer tasks, while those receiving systematic (sequential) sequences performed better on retention tasks. Both groups had equal learning gains during training. Although no direct or approximate replication appears to have been run on preschool children, Kobasigawa and Orr (1973) offered some data that were consistent with Cartwright's. Their data showed that normal kindergartners could recall more stimuli, if the stimuli (four items) were grouped on presentation by category (e.g., four instances of vegetables) versus four items from different categories (e.g., a vegetable, an animal, a piece of furniture, and a vehicle). Unfortunately, Kobasigawa and Orr did not measure transfer skills. These two studies can hardly be ruled conclusive so that the only principle to be derived is that the choice of the mode of stimulus presentation may depend on the instructional objective(s).

III. IMPLICATIONS

Implications for Research

Many paths of research on printed academic materials and preschool-age children remain unexplored or seldom walked. These paths might lead to significant advances in early childhood education, if more systematically explored. There are both wide and narrow paths that need to be followed, which are subsequently discussed.

The main path of future research should be dominated by several features. (1) Studies on printed academic materials should be run on several, separate age groups of preschool children (e.g., 3-, 4-, and 5-

year-old children) so that age-related trends might be uncovered. (2) Investigators should conduct studies in which the performance of (at least) two-of-three groups of children (i.e., normal, at-risk, and handicapped) are compared so that the differential educational needs (if any) of major groups of children can be met. (3) Researchers should measure not only acquisition performance but also generalization and/or second-order effects. An elaboration on these three features of future research on printed academic materials seems warranted.

Future inquiry should probe age interactions for both theoretical and practical reasons. Age-related effects have been widely documented in educational and psychological literature, and there is every reason to believe that some of the effects of the stimulus properties of printed academic materials will be age related (e.g., Rudisill, 1952; Travers, 1969). The further identification of age-related trends would broaden our knowledge about the growth of human cognition, regardless of sympathy to either an environmental or epigenetic theory of human behavior. Practically, data on age-related trends might be useful for two purposes: (1) practitioners and instructional technologists might use the information to construct materials that produce few correct responses by target age groups, since previous research has suggested that errors beget errors (e.g., Sidman & Stoddard, 1966); and (2) the information might be used to construct probes within materials that could be used in an on-going assessment to pinpoint developmental delays (e.g., Etzel, Note 1) which would permit early identification and remediation.

The identification of age-related trends, however, presents formidable experimental-design problems. The most frequent design tactic (whether for group or individual-analysis studies) is to use a cross-sectional approach, wherein several age groups are sampled. Such an approach is fraught with confounds: time of testing, birth cohort, and the object of measurement--age-related effects. How can these confounds be controlled? Time of testing can be controlled by testing additional groups of children at x time interval later, so long as the new groups are the ages of the original children at the first measurement; if the resulting data show the same pattern of measurement exists for both groups, then time of measurement can be ruled out as a possible confound; if, however, one group shows a markedly different level of scores across all of the age categories, then something peculiar to the time of measurement contributed to the result. Cohort effects can be similarily identified. If one group of children shows a linear change in scores as a function of ascending age and the other group of children show no change as a function of age or an opposite function, then the investigator may assume that the results were peculiar to the given cohorts. True age-related effects can be said to exist only if the same pattern in the data is noted across times of testing and sampled cohorts. A number of articles have been written on criteria for developmental studies (e.g., Baltes, 1968) which the interested reader may wish to consult.

The appropriate design for developmental studies is certainly elegant, but expensive and premature in many cases. Such a design should not be run unless one has good reason to believe that there are strong age-

related effects associated with the independent variable under study; otherwise much time may be spent pursuing a very weak or non-existent variable. In lieu of prior research findings which might guide a decision to use the design, one might run a one-shot cross-sectional study. A finding that indicated no differences associated with the cross-sections of ages would suggest that any age-related effects were highly improbable, which would argue against the utilization of a more sophisticated design to tease out developmental trends. A finding of a clear relationship between the cross-section of ages and the dependent variable would suggest the possibility of true developmental trends, which would confer face validity to the application of the more sophisticated design.

Children may be grouped by categories other than age; a preschool child might be "normal," at-risk for a variety of handicaps, or actually handicapped. Information on the differential effects of certain stimulus characteristics of printed academic materials on children with varying degrees of handicapping conditions (if any) would be most valuable to early childhood educators. Such information might aid in the construction of new procedures for the early identification of children at-risk for handicapping conditions; it could also guide the development of instructional materials optimally effective for these various groups of children. Researchers who attempt to probe for interactions with varying degrees or kinds of handicapping conditions must clearly articulate their definitions for classifying children (a very significant concern with "at-risk" children) so that findings are meaningful and replicable.

Most previous studies have measured only acquisition responses and have forgone any assessment of second-order effects or generalization. This prevailing deficiency is most unfortunate, since instructional technology is developing to the point that acquisition can be assured in many cases. Thus, it becomes more and more important to identify second-order effects (e.g., facilitation of future learning, long-term retention, or response covariants) or generalization effects (i.e., improved performance on a typographically or functionally similar response). These additional data would add to our theoretical knowledge about any nexus of antecedents, behaviors, and consequences, although such knowledge is unlikely to resolve the on-going argument about the degree of independence between human behaviors. Pragmatically, these data would aid early childhood educators in calculating the cost-benefit ratios of various instructional procedures. This suggested protocol for future inquiry is not a call for research on minutiae, rather it is a call for the measurement of significant responses logically related to the target behavior(s) being taught.

Some narrower, more specific paths of future research need to be discussed, which reflect the features of the broader path.

COLOR. A number of aspects about the use of color merit further inquiry. It is not known how the use of color in storybooks affects the prose comprehension of young children or linguistic transformations, which should be of considerable practical interest since it has been shown that storybooks can significantly affect those variables (e.g., Boroughs, 1970; Guttman et al., 1977); if such studies are conducted in classroom settings, it would be good to measure children's attention to task and disruptions,

since it was noted earlier in the paper that children have a preference for color. As outlined in previous paragraphs, these studies should be conducted on children of varying ages and degrees of handicapping conditions.

INSTANCES OF CONCEPTS. The reviewed research on instances of concepts, which was conducted on elementary-school children, needs to be replicated on preschool-age children. Careful attention should be paid to transfer, retention, and recall issues.

LANGUAGE STYLE. The effects of direct versus non-direct discourse (used in storybooks) should be examined on the prose comprehension and imitation of young children. Furthermore, the differential effects of 1st-person versus 3rd-person pronouns on imitation by preschool children merits further investigation; such studies might examine a variety of imitative beahviors: speech, academic behaviors, and social behaviors.

PICTURES AND DRAWINGS. Further studies on the effects of pictures or drawings on sight reading are clearly warranted. Such studies should compare no pictures, superimposed pictures, and faded pictures; the studies should go beyond measuring acquisition to measure retention, and any facilitating effects on learning new words and/or textual-reading responses. Care should be taken to insure that the various conditions do not possess implicit differences in schedules of reinforcement. The research of Levin et al. (1976) and Guttman et al. (1977) should be systematically replicated in early childhood education settings; appropriate/inappropriate behavior of children, teacher attention, as well as prose comprehension should be monitored. Variables found to affect prose comprehension might become

potential independent variables for studies of storybook imitation, given Whitehurst's (1977) comprehension-imitation-production hypothesis.

PREFERENCES OF CHILDREN. A number of issues about children's preferences remain unresolved. It is not known, for example, whether the kinds of preferences for pictorial stimuli noted by Rudisill (1952) and French (1952) are manifested in their preferences for certain instructional materials in the classroom or the home. Further, it is not clearly known what if any affects those preferences have on academic responses or imitative behaviors. Finally, the hypothesis on reinforcement history, stimulus novelty, and child preference articulated previously, requires direct verification.

SUCCESSIVE VERSUS SIMULTANEOUS PRESENTATIONS. Researchers could fruitfully investigate some unresolved questions about successive versus simultaneous stimulus presentation. More studies are required that measure retention and transfer as well as acquisition. Until such measurements are made, it will be difficult to make a conclusive recommendation for practice. Similarily, many of the studies need systematic replication with younger children (e.g., Smuckler, 1967; Schelly, 1973).

Implications for Practice

The literature reviewed herein permits some tentative conclusions, which might be useful to teachers or instructional technologists involved in early childhood education. The strength of these conclusions will be tested, no doubt, in the coming decade of research. Current implications for practice are as follows:

(1) The use of realistic color would appear indicated for storybooks or storybook analogs, but the use of color in discrimination tasks is dictated by whether color is relevant to the discrimination. Color-irrelevant cues may be aesthetically pleasing, but they may increase children's errors--especially among populations with a tendency toward overselectivity.

(2) If storybooks or their analogs are used with a memory or imitative instructional objectives in mind, the photographs may be preferable to drawings.

(3) When teaching a concept to a young child, the ratio of positive to negative instances should be quite high. Negative instances are necessary to reduce the probability of overgeneralization.

(4) The passive voice should not be used in printed instructional materials for young children, since its use adversely affects children's comprehension.

(5) In storybook narratives, the use of first-person pronouns would appear to facilitate imitation.

(6) The initial trials of a new instructional task should minimize a child's probability of making an error, because children will perform with fewer errors on later trials requiring more difficult discriminations.

(7) Picture cues appear to be an especially effective way of teaching sight words to young children (even those with serious handicaps)--especially if the picture cues are faded over trials. The child's later reading responses might be facilitated if the picture-fading technique is foregone, after the child has acquired some repertoire of basic sight words.

(8) In the construction of storybooks, children's iconic comprehension should be tested without the accompanying prose so that congruence between pictures and prose is assured.

(9) Children appear to benefit if required to make or to observe other children make frequent active responses with respect to the printed academic materials.

(10) In constructing memory games or tasks for young children, more items will be recalled if the items presented during each trial are of the same category (e.g., all birds versus some fruits, cars, or animals).

These ten suggestions do not exhaust the possible practical implications from the literature reviewed, but other inferences are somewhat more tenuous since the supporting data are more amgibuous themselves.

IV. CONCLUSIONS

The studies cited in this review, taken as a whole, suggest that variations in printed instructional materials constitute a salient dimension in the behavioral ecology of early childhood education settings. These variations - acting in concert with other behavioral antecedents and consequences - can be utilized by teachers and instructional technologists to alter the outcomes of early childhood education for either normal, at-risk, or handicapped children.